

EXHIBIT 16



SIMON™

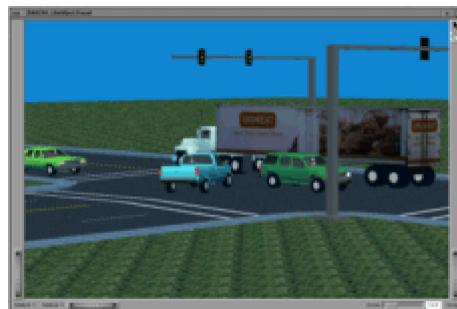
📁 CATEGORY: SOFTWARE



SIMON™

SIMON (SImulation MOdel Non-linear)

SIMON was specifically designed to take advantage of the rich feature set available in the HVE simulation environment, including the HVE Brake Designer, ABS Simulation Model, Driver Model, Tire-Terrain Models, Tire Blow-out Model and the patented DyMESH 3-D Collision Model. SIMON has been validated against several well-



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instrumented vehicle handling studies, including combined steering and braking, severe irregular terrain traversal, rollover tests, staged crash tests and tire blow-out experiments. SIMON is a dynamic

simulation of the response of one or more vehicles to driver inputs, factors related to the environment (e.g. terrain, atmosphere) and inter-vehicle collision(s). SIMON was built from the ground up employing the latest advances in software and simulation technology. SIMON uses a new, general purpose 3-D vehicle dynamics engine developed by Engineering Dynamics Corporation. The dynamics engine allows a sprung mass with six degrees of freedom and unsprung masses with up to five degrees of freedom per axle. Each vehicle model may have up to three axles (six axles for full trailers) and single or dual tires. Independent and solid axle suspension types are allowed.

SIMON may be used for numerous types of simulation studies. Applications for SIMON include:

Single Vehicle Simulation - SIMON incorporates robust non-linear tire and suspension models required for vehicle handling simulation studies, such as ISO 3888 severe lane change or limit maneuvers. SIMON also includes a comprehensive drivetrain model with engine performance parameters, multi-gear transmissions and differentials.

Articulated Vehicle Simulation - SIMON can simulate the dynamics of articulated multi-vehicle trains. The model is general and allows the user to simulate

virtually any vehicle/trailer configuration, including A-trains, B-trains and AB-combinations.

Collision Simulation - SIMON incorporates **DyMESH®**, a general-purpose, 3-D non-linear collision model for simulating vehicle-to-vehicle and vehicle-to-barrier collisions. **DyMESH** calculates 3-D forces and moments between the interacting meshes of each vehicle



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model. SIMON includes these collision forces and moments with suspension forces, aerodynamic forces and inter-vehicle connection forces to produce the total vehicle-fixed forces and moments acting on the vehicle at each timestep. The resulting body damage is visualized as the 3-D mesh geometry changes during the event,

Vehicle Design - SIMON may be used for vehicle design projects involving suspension, brake, tire and steering systems. Using SIMON, these systems may be optimized on the computer before expensive prototyping and testing begins. For example, compliance tests for braking systems, such as FMVSS 105 and FMVSS 135 can be simulated for any vehicle prior to actually fitting a prototype with a specific brake design. Parametric studies involving

in-use factors, such as weight distribution changes due to occupant loading and payload location, may also be performed.

Safety Research - Safety researchers may use SIMON for reconstructing most crashes involving single or multiple vehicles. Human, vehicle and environment factors may be simulated and evaluated to assist in performing detailed crash studies. Typical human factors issues include driver inputs and speed; vehicle factors include brake system and suspension design, loading conditions, and tire properties; and environment factors include superelevation and slippery road conditions.

SIMON employs full 3-dimensional engineering models with up to 21 degrees-of-freedom per vehicle. The user assigns initial position, velocity and driver controls (steering, braking, throttle, gear selection) for each vehicle. Trailers and dollies are automatically positioned behind a tow vehicle according to connection compatibility and location. A payload and up to 9 human occupants may also be positioned in each vehicle. SIMON then predicts the motion of each vehicle's sprung mass (X, Y, Z, roll, pitch, yaw), the motions of the unsprung masses (wheel deflections, spin velocities), suspension dynamics (spring forces and deflections, axle accelerations), tire dynamics (forces, moments and slip angles at the tire/road interface), and current

brake system parameters at each wheel (air pressure, brake torque, lining temperature). Numerous other output parameters are also available. Vehicle body damage from a collision simulation is also calculated and displayed using HVE's 3-D viewers.

An environment is optional. If supplied, the environment may be a simple flat surface or complex 3-D digital terrain map (DTM) from a total station survey. Environment models are typically built for simulation studies involving proving grounds, specific roads and crash sites. An unlimited number of friction zones may be supplied. Tire vs terrain interaction is modeled transparently to the user. This powerful capability allows the user to create a detailed, 3-D environment (using HVE's 3-D Editor or any popular modeling package), then drive a vehicle on it. At each timestep, the SIMON tire model queries the environment to use the current elevation, surface normal vector and friction beneath each tire. Using SIMON, a vehicle may be simulated driving on virtually any surface under any conditions, including airborne vehicles.

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[Back to top](#) 